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Author Affiliation:

¹Tribhuvan University, Sanathimi Campus, Bhaktapur, Nepal

²Tribhuvan University, Mahendra Ratna Multiple Campus, Ilam, Nepal

*Corresponding Author

Tribhuvan University, Sanathimi Campus, Bhaktapur, Nepal

Email: rajendrailam@gmail.com

Contact List

| | |
|-----------------------|---------------------------|
| Rajendra Kunwar | rajendrailam@gmail.com |
| Jagat Krishna Pokhrel | jagatpokrrel.tu@gmail.com |
| Hari Prasad Sapkota | hpsapkota11@gmail.com |

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Dyslexia: Meaning, evolving concepts and its current practices in school-level mathematics in the Nepalese context

Rajendra Kunwar^{1*}, Jagat Krishna Pokhrel¹, Hari Prasad Sapkota²

ABSTRACT

Dyslexia is a neurodevelopmental disorder that impairs an individual's capacity to read, write and spell with precision and fluency. This is a common learning disability that can have a significant impact on a person's academic performance, especially in math. This paper explores the meaning, definition and evolving concept of dyslexia and its current practice in school mathematics in Nepali. This article reviews the existing literature on dyslexia, including its definition and prevalence and highlights the challenges faced by dyslexic students when learning mathematics. This article also looks at the current mathematical practices and strategies used by Nepalese schools to support dyslexic students. In addition, the article makes suggestions for improving support for dyslexic students in mathematics.

Keywords: Dyslexia, evolving concepts, learning disability, school-level mathematics

1. INTRODUCTION

Dyslexia is a type of learning disorder that impairs an individual's capacity to read, write and spell with precision and fluency. Dyslexia is an emerging area of research and practice, with limited understanding of its prevalence, characteristics and impact on mathematics learning. It is a neurological condition that is believed to have a genetic basis and affects the phonological processing skills of the human brain (Shaywitz, 2003). Dyslexia is characterized by difficulties in decoding words, spelling and recognizing sight words, which can result in reading comprehension difficulties and impact a person's overall academic performance (Hulme and Snowling, 2016).

Although dyslexia is commonly associated with difficulties in reading, it can also affect other areas of learning, including mathematics. In the Nepalese context, dyslexia is an emerging area of research and practice, with a limited understanding of its prevalence, characteristics and impact on mathematics learning. Mathematics is a core subject in the school curriculum and students with dyslexia may face challenges in understanding mathematical concepts,

problem-solving and memorizing mathematical facts. Therefore, it is crucial to explore the concept, meaning and evolving concepts of dyslexia in the context of mathematics learning in Nepalese schools. Also, it is vital to identify the current practices and strategies used to support students with dyslexia in this domain.

This article aims to explore the meaning, definition and evolving concepts of dyslexia and its current practices at the school level in the Nepalese context. This study uses the comprehensive review of relevant literature on the evolving concepts of dyslexia and its current practices at the school level as the method of study.

Meaning and Definition of Dyslexia

The word dyslexia come from the Greek roots "dys" meaning difficulty or abnormality and "lexis" meaning language or words (Lyon et al., 2020). The term was first coined in the late 19th century by the German ophthalmologist Rudolf Berlin, who used it to describe a group of individuals who had difficulty reading despite having normal vision (Shaywitz, 2003). According to Learning Disabilities Association of America, (2020), common symptoms of dyslexia include difficulty identifying letters and matching letter names and sounds, slow and inaccurate reading, poor reading comprehension, difficulty with memorization and recall, finding written instructions or conversations confusing, frequent misspelling of words, poor written expression and struggling to organize thoughts in writing.

However, dyslexia manifest uniquely in each individual, so all symptoms are not present in every case. Dyslexia makes it challenging to recognize the visual symbols that represent language and amounts to weaknesses in processing linguistic information rather than low intelligence (Berninger et al., 2008). Individuals with dyslexia have trouble with the fluent, accurate recognition of words, recalling the names of letters, associating letters with sounds, reading fluently, comprehending what they read and expressing thoughts in writing (International Dyslexia Association, 2018).

According to recent studies Cunningham et al., (2021) and Georgiou et al., (2021), dyslexia is often linked to particular deficiencies in various cognitive functions, such as phonological processing, rapid automatized naming, orthographic processing, processing speed and verbal working memory, are often affected in individuals with dyslexia. While dyslexia is not due to a lack of educational opportunity or low cognitive ability, it can co-occur with other conditions like attention deficit hyperactivity disorder (ADHD) (Willcutt et al., 2012). About 5% of individuals have dyslexia, making it the most prevalent learning disability (Moats, 2006).

The modern definition of dyslexia has since evolved to encompass a broader range of reading-related difficulties that are thought to be caused by underlying neurological differences in the brain (Lyon et al., 2020). Dyslexia refers to a learning disability characterized by difficulties with reading, writing, spelling and sometimes math. It is a neurologically-based condition that originates in the brain (Zinna, 2019). It is a neurological condition that affects reading ability despite normal intelligence, vision, hearing and adequate instruction (Shaywitz, 2003).

The common features of dyslexia, as described by Lyon et al., (2020), are challenges in achieving precise and/or smooth word recognition, combined with subpar spelling and decoding skills. Dyslexia can have a significant impact on an individual's academic and social development and it is estimated to affect around 3-7% of the population (Landerl et al., 2013; Peterson and Pennington, 2015). Similarly, the prevalence of dyslexia varies widely across studies. The prevalence of dyslexia varies depending on the sources consulted, with estimates ranging from 7% of the worldwide population (Yang et al., 2022) to as high as 20% of school-aged individuals (Shaywitz and Shaywitz, 2020).

However, it should be noted that the prevalence rates of dyslexia can vary greatly. Thus, dyslexia refers to a lifelong neurologically-based learning disability characterized by difficulties with reading, writing, spelling and mathematics resulting from weaknesses in processing language. Dyslexia makes it more challenging to acquire these fundamental skills of an individual however, by applying appropriate support, instruction, accommodation and technology, people with dyslexia can achieve success in school, at work and in life (Taylor and Vestergaard, 2022).

The concept of dyslexia has evolved over the years, with ongoing research and advancements in the field of neuroscience, psychology and education. Dyslexia was initially described as a visual processing disorder (Shaywitz and Shaywitz, 2020), but later research revealed that it is primarily a phonological processing disorder, affecting the ability to recognize and manipulate speech sounds (Snowling, 2018). As per the International Dyslexia Association, (2018), dyslexia is a particular learning disability with a neurobiological basis. It is marked by challenges with accurate and/or fluent word recognition, as well as inadequate spelling and decoding abilities. Dyslexia is a heterogeneous condition, with varying degrees of severity and manifestations in different individuals (Peterson and Pennington, 2015).

Historically, dyslexia was viewed as a visual-perceptual disorder, with some researchers suggesting that individuals with dyslexia had difficulty processing visual information related to reading (Taylor and Vestergaard, 2022). However, more recent research has found that dyslexia is primarily a phonological processing disorder, meaning that individuals with dyslexia have difficulty processing the sounds of language, which can lead to difficulties in decoding words and recognizing sight words (Muktamath et al., 2022; Shaywitz, 2003).

The phonological processing theory of dyslexia is supported by research showing that individuals with dyslexia have difficulty with tasks that require phonological awareness, such as identifying rhyming words or manipulating sounds within words (Ramus et al., 2013; Stanovich, 1988). Additionally, brain imaging studies have found that individuals with dyslexia show differences in brain activation patterns when processing phonological information, compared to typically developing readers (Shaywitz and Shaywitz, 2020).

Dyslexia is considered a complex condition that can affect individuals in different ways and researchers continue to explore the various factors that contribute to dyslexia. It has also been found that dyslexia is associated with differences in visual processing, attention and working memory (Peterson and Pennington, 2015). Thus, dyslexia is now conceptualized as a multifactorial disorder that is influenced by both genetic and environmental factors (Pennington, 2006). While there is no single cause of dyslexia, research suggests that a combination of genetic predisposition and environmental factors, such as exposure to language and literacy experiences, can contribute to the development of dyslexia (Snowling and Hulme, 2012).

2. CONCEPTUAL DEVELOPMENT OF DYSLEXIA

Initially, dyslexia was recognized as a visual-spatial or phonological deficit that hinders the perceptual processing of language (Rasanen et al., 2014). Early interventions were focused on enhancing sight word memorization, phoneme-based instruction and decoding techniques (Shaywitz, 2003). Dyslexia is a neurodevelopmental disorder that impairs reading, spelling and writing skills (Fraga-González et al., 2018). The conceptualization of dyslexia has evolved over time, beginning with the earliest descriptions of the disorder and progressing to the present understanding of its etiology and underlying neural mechanisms.

In the late nineteenth century, German physician Adolf Kussmaul introduced the term "word blindness" to describe a group of patients who had difficulty reading despite having normal vision and intelligence (Kirby et al., 2020). In the early twentieth century, the British physician W. Pringle Morgan reported a case of a boy with severe difficulty in reading and spelling, which he attributed to a congenital defect. Dyslexia was recognized as a specific learning disability in the mid-twentieth century and was included in the Diagnostic and Statistical Manual of Mental Disorders DSM-5 (American Psychiatric Association, 2015).

Such a disorder can malfunction in the underlying neuropsychological processes and result in significant harm to the individual's ability to function in society (Fraga-González et al., 2018). This harm must be clinically significant and lead to a disturbance in the individual's overall functioning. However, it was not until the 1970s that dyslexia began to be systematically studied, leading to a more refined understanding of its characteristics and underlying neural mechanisms. Current research suggests that dyslexia is a multifaceted disorder that results from a complex interplay of genetic and environmental factors (Theodoridou et al., 2021).

Such environmental factors may act as the triggering factors causing the disorder of an individual. Studies have shown that dyslexia is associated with structural and functional differences in the brain, particularly in regions involved in language processing and phonological awareness. In the study, Hoeft et al., (2007) observed diminished activation in two brain regions essential for reading and phonological processing, namely the left inferior parietal lobule and left fusiform gyrus, in children diagnosed with dyslexia. Another study by Norton et al., (2014) demonstrated that children with dyslexia showed decreased gray matter volume in the left inferior parietal lobule and left middle temporal gyrus, suggesting that these regions may play a crucial role in the development of reading skills.

Thus, the conceptual development of dyslexia has significantly advanced over the past century, from initial descriptions of the disorder to the current understanding of its underlying neural mechanisms. In recent times, biological as well as psychosocial factors are introducing as the new approach to early diagnosis and intervention for dyslexic children effectively (Theodoridou et al., 2021). The insights gained from studying the complex nature of dyslexia have significant implications for diagnosing and treating the disorder and for designing educational interventions that can help individuals with dyslexia succeed both academically and in their personal lives.

Evolving Concept of Dyslexic

The concept or idea of dyslexia is continually changing or developing over time. The concept of dyslexia has been widening in terms of changing societal attitudes and beliefs, as well as the enhancement of technology. In recent years, the concept of dyslexia has evolved, with ongoing research and advancements in neuroscience, psychology and education. The understanding of dyslexia has expanded beyond a narrow view of a reading disorder to a broader perspective that recognizes the complex nature of the condition and its impact on various cognitive processes, including mathematics. Early conceptualizations of dyslexia viewed it as a visual processing deficit or a result of poor teaching or inadequate intelligence (Snowling, 2018).

However, the current understanding of dyslexia emphasizes its neurobiological basis, involving difficulties in phonological processing, rapid automatized naming and other cognitive processes (Peterson and Pennington, 2015). So, the meaning and interpretation of dyslexia have shifted or evolved from a narrow view of a visual processing disorder to a broader, more nuanced understanding of a complex neurological condition that impacts reading and other areas of cognitive functioning (Kirby et al., 2020). In the beginning, it was viewed as difficulty with automatizing skills, rapid naming, verbal fluency and working memory rather than low IQ (Berninger et al., 2008).

The concept of dyslexia has evolved significantly with new research leading to a greater understanding of the underlying neurological differences and a wider recognition of the spectrum of symptoms and severity. Dyslexia is now recognized as a neurological condition that affects reading ability despite normal intelligence, vision and hearing (Shaywitz, 2003; Kirby et al., 2020). The underlying neurological differences in the brains of individuals with dyslexia impact phonological information processing (Shaywitz, 2003).

Dyslexia is now seen as a spectrum disorder that can vary in terms of severity and symptoms. Some individuals with dyslexia may struggle with reading fluency and accuracy, while others may have difficulty with spelling and writing (Peterson and Pennington, 2015). There is growing recognition of the importance of early identification and intervention for individuals with dyslexia. Dyslexia is now understood to be a lifelong condition that can impact an individual's academic and social development. However, with appropriate support and interventions, individuals with dyslexia can learn to manage their difficulties and achieve their full potential (Peterson and Pennington, 2015).

Historically dyslexia is viewed as a strictly perceptual or language-based disorder, however, the concepts of dyslexia have broadened to encompass cognitive, social and emotional aspects. Today, the concept of dyslexia is used as a broad term and conceptualized from broader perspectives. According to Fletcher et al., (2018), dyslexia is currently recognized as the most prevalent specific learning disability that adversely affects an individual's reading and spelling abilities and its etiology is influenced by a combination of neurobiological, genetic and environmental factors. Similarly, cognitive theories consider dyslexia a language-based learning disability arising from weaknesses in phonological processing, rapid naming, working memory, fluency and accuracy of processing skills underlying reading fluency and comprehension (Vellutino et al., 2007).

This often experiences cognitive difficulties of the child that can include speech perception, difficulties recognizing and manipulating the basic sounds in a language, language memory and challenges with learning the sounds of letters. These difficulties are related to the underlying neurological differences in the brain, which are believed to have a genetic basis (Shaywitz, 2003). On the other hand, sociocultural theories consider how dyslexia evolves from interactions between individual, environmental and cultural factors (Smith, 2015). Socioeconomic status, stigma, lack of disability rights and scarce support resources negatively impact dyslexic individuals in society (Reid and Valle, 2004).

The negative self-perceptions of children, particularly those with dyslexia, can be influenced by various external factors such as their environment, relationships and the understanding of their teachers (O'Brien, 2021). Thus, it is crucial to gain a comprehensive understanding of contextual factors that affect children and utilize this knowledge to enhance outcomes for all children, including those with dyslexia. This theory focuses on support to the child in every step of his/her difficulty. Today, dyslexia is a broad term for a group of disorders manifested uniquely across individuals (Roodenrys et al., 2020). It refers to weaknesses in skills underlying reading, writing, spelling and sometimes math resulting from differences in language processing (Lyon et al., 2020).

Now, the common characteristics of dyslexia are supposed difficulties with lexical access, automaticity, working memory, processing speed, organization, time management and emotional regulation (Smith-Spark and Gordon, 2022). It is viewed on a continuum with individuals demonstrating weaknesses in one or more of these areas. Thus, it is needed a cohesive, scientific explanation integrating neurological, cognitive and sociocultural elements to diagnose and intervene in dyslexic children (Brunswick et al., 2010; Smith-Spark and Gordon, 2022). The concept of dyslexia continues evolving from a visual-spatial deficit to a neurologically-based language learning disability to a sociocultural condition (O'Brien, 2021; Smith-Spark and Gordon, 2022).

The future of the field depends on developing integrated perspective recognizing dyslexia as a lifelong condition shaped by complex interactions between individual abilities, environmental influences, cultural beliefs and societal practices. Thus, necessitate a multi-pronged approach including explicit instruction, motivation, social-emotional support and assistive technology for prevention and remediation (Fletcher et al., 2018) and can be supported through the use of technology, inclusive practices, social policies, access to resources and developed awareness/acceptance. Hence, dyslexia has broadened concurrently with supportive approaches evolving from deficit-based to evidence-based, inclusive and multi-faceted practices with improved identification techniques and support.

3. CURRENT PRACTICES OF DYSLEXIA AT SCHOOL-LEVEL MATHEMATICS IN NEPAL

Dyslexia is specifically characterized by difficulties in decoding words, spelling and recognizing sight words, which can result in reading comprehension difficulties and impact a person's overall areas of learning, including mathematics. In Nepal, dyslexia is an emerging area of research and practice, with a limited understanding of its prevalence, characteristics and impact on mathematics learning.

Mathematics is a core subject in the school curriculum and students with dyslexia may face challenges in acquiring mathematical skills and understanding mathematical concepts. Therefore, it is crucial to explore the current practices of dyslexia in the context of mathematics learning in Nepalese schools and identify the strategies used to support students with dyslexia in this domain. However, it has not been officially recognized as a disorder, the majority of the population does not seek any form of assistance for it (Sharma and Mahapatra, 2019).

There is limited awareness and understanding of dyslexia among the general public, education professionals, policymakers and government agencies (Amatya et al., 2019). There are no standardized tools for diagnosing dyslexia in Nepal (Pandey, 2019). Diagnosis depends on teachers' observations, informal assessments and comparisons to peers (Karki, 2018). In Nepal, the education system has been implementing inclusive education policies. These findings emphasize the importance of implementing inclusive educational policies aimed at ensuring equal opportunities for all students, including those with disabilities such as dyslexia.

However, the implementation of these policies in relation to dyslexia and mathematics learning is still in its early stages. There is a lack of awareness and understanding among teachers and schools about dyslexia and its impact on mathematics learning, which may result in limited support for students with dyslexia in this area. A study conducted by Kunwar et al., (2021) indicates that a significant proportion of elementary school teachers lack adequate knowledge about their students' difficulties with learning mathematics, particularly in the context of specific learning disabilities.

Furthermore, the understanding of dyslexia is influenced by cultural and linguistic factors (Maunsell, 2020). In the Nepalese context, where Nepali is the dominant language, the linguistic characteristics and writing system of Nepali may have unique implications for dyslexia assessment and intervention. Additionally, cultural beliefs and practices may impact the recognition and perception of dyslexia in the Nepalese context. Although the understanding of dyslexia has been advancing worldwide, there is a dearth of research on the identification and support of students with dyslexia within the context of the Nepalese education system. Hence, most dyslexic students have not gotten proper intervention (Poudel, 2015) causing a lack of expertise in evidence-based dyslexia practices (Sharma, 2017).

Similarly, Pre-service and in-service teacher training regarding dyslexia is scarce (Shrestha, 2019). Most teachers lack knowledge about the characteristics of dyslexia, identification procedures, evidence-based interventions or accommodation strategies (Tharu, 2016). There are no specific laws or policies protecting the rights of individuals with dyslexia in Nepal and have limited advocacy (Pandey, 2019). It is evident that there is a clear need for creating awareness, enhancing identification procedures, formulating evidence-based practices, implementing supportive policies and advocating for legal reforms to safeguard the rights of individuals affected by this issue, as noted by Acharya et al., (2018).

While resources for and practices supporting dyslexic individuals in Nepal remain limited, recognition of dyslexia and progress is improving gradually through advocacy, awareness raising and research (Shrestha, 2019). With continued efforts, Nepal can strengthen identification procedures, expand evidence-based intervention approaches, establish formal policies ensuring rights protection, improve teacher training on dyslexia and build supportive systems enabling the success and well-being of dyslexic people.

There is no official data on dyslexic students in Nepal (Amatya et al., 2019). Dyslexic students are not identified or diagnosed, so do not receive any official recognition, accommodation or support (Pandey, 2019). Similarly, due to the lack of recognition and resources, limited support has been provided (Pandey, 2019). Current practices for identifying dyslexia at the school level involve a multi-tiered approach, including screening measures, formal assessments and monitoring progress over time (Lyon et al., 2020).

Large-scale epidemiological studies on learning disorders and dyslexia have not been conducted in Nepal; however, small-scale studies have attempted to estimate the prevalence of reading and writing difficulties among school-aged children.

A study, conducted by Thapa, (2018) taking 554 primary school children, estimated the prevalence of dyslexia to be 13.54% based on screening outcomes. However, after distinguishing false positive cases through direct assessment, the estimated prevalence of dyslexia was 12.82%. This highlights the need for greater awareness and understanding of dyslexia in Nepal. This also indicates that further studies are also needed to better understand the nature and prevalence of dyslexia.

4. CHALLENGES FACED BY DYSLERIC LEARNER IN NEPAL

Dyslexia is a learning disability that affects a person's ability to read and write due to differences in brain function. People with dyslexia commonly encounter difficulties with reading comprehension, vocabulary development and general learning, but their intelligence and overall developmental growth are not necessarily impacted. Despite this, individuals with dyslexia are often unfairly stigmatized as being lazy or unintelligent, when in reality their struggle is primarily with reading. Dyslexia presents clear obstacles to reading and writing, which in turn can hinder comprehension and impede effective learning. Dyslexia's effects extend beyond mere difficulties with reading and writing. Those with dyslexia may feel stigmatized as unintelligent or lazy, leading to disengagement from learning and even depression.

A dyslexia diagnosis is not a label of incompetence, but rather an indication that special accommodations and support are needed to help individuals with dyslexia succeed. With the right interventions and support, individuals with dyslexia can overcome their challenges and achieve their full potential. The dyslexic learner may face various challenges depending on the personal and social factors as well as viability of the resources (O'Brien, 2021). Similarly, developed countries have established mechanisms for providing special teacher training, managing classrooms and incorporating effective technologies in teaching however, in underdeveloped countries, where the situation is different (Kunwar and Sapkota, 2022).

In such countries, the term "dyslexia" is still relatively new and teachers have not received specialized training on how to teach dyslexic children, nor do they possess sufficient knowledge on the subject so, they face more challenges. As mentioned earlier, research on dyslexia in Nepal is limited, but there are a few studies and reports that have highlighted some of the challenges faced by dyslexic learners in the country. In Nepal, dyslexia is often not well understood by educators and the general public, which can lead to misdiagnosis, inappropriate treatment and a lack of support for dyslexic learners (Thagunna and Sapana, 2019). Similarly, dyslexic learners in Nepal may face stigma and discrimination from their peers and teachers, which can lead to low self-esteem and a lack of confidence in their abilities (Poudel, 2015; Shrestha, 2019).

Limited access to resources and support are other challenges for the dyslexic learner to specialized support systems, such as trained professionals and specialized schools. This can make it difficult for dyslexic learners to receive appropriate accommodations and support in schools and other educational settings (UNESCO, 2018). Language barrier is another challenge for Nepali dyslexic learner. Nepal has a diverse linguistic landscape and dyslexic learners who speak languages other than Nepali may face additional challenges in learning to read and write.

5. CONCLUSION

This study on the evolving concepts of dyslexia and its current practices at the school level has shed light on the understanding, identification practices and intervention strategies for dyslexia in educational settings. The findings highlight the need for increased awareness and understanding of dyslexia as a neurobiological condition involving difficulties with phonological processing. The study also revealed inconsistencies and gaps in dyslexia identification practices, suggesting a need for standardized and evidence-based approaches for identifying students with dyslexia in schools. Furthermore, challenges in implementing evidence-based interventions for dyslexia, such as limited resources and specialized training, were identified, indicating the need for comprehensive and coordinated approaches to intervention.

Informed consent

Not applicable.

Ethical approval

Not applicable.

Conflicts of interests

The authors declare that there are no conflicts of interests.

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Data and materials availability

All data associated with this study are present in the paper.

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